A

Practitioner's Docket No. 460-008437-US(PAR) **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of

Inventor(s): Jarno KNUUTILA; Jari TOIVANEN; Janne JUHOLA; Markku LIPPONEN; Ari AHO; Janne HAAVISTO; Kaj SAARINEN

WARNING: *37 C.F.R. § 1.41(a)(1) points out:*

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors."

For (title):

METHOD FOR TRANSFERRING IMAGE INFORMATION

CERTIFICATION UNDER 37 C.F.R. 1.10*
(Express Mail label number is mandatory.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as attached therein are being deposited with the United States Postal Service on this date January 19, 1999 in an envelope as "Express Mail Post Office to Addressee," mailing Label Number EL067101068US addressed to the: Assistant Commissioner for Patents, Washington, D.C. 20231.

Elaine Mian
(type or print name of person mailing paper)

Elaine F. Mian
Signature of person mailing paper

WARNING: *Certificate of mailing (first class) or facsimile transmission procedures of 37 C.F.R. 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.*

WARNING: *Each paper or fee filed by "Express Mail" **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 C.F.R. 1.10(b).*
*"Since the filing of correspondence under § 1.10 without the Express Mail mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition." Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439, at 56,442.*

1. Type of Application

This new application is for a(n)

(check one applicable item below)

☒ Original (nonprovisional)

☐ Design

☐ Plant

WARNING: *Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4), unless the International Application is being filed as a divisional, continuation or continuation-in-part application.*

WARNING: *Do not use this transmittal for the filing of a provisional application.*

NOTE: If one of the following 3 items apply, then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION.

☐ Divisional.

☐ Continuation.

☐ Continuation-in-part (C-I-P).

2. Benefit of Prior U.S. Application(s) (35 U.S.C. 119(e), 120, or 121)

NOTE: A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. 112. Each prior application must also be:

(i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or

(ii) Complete as set forth in § 1.51(b); or

(iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or

(iv) Entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the time period set forth in § 1.53(f).

37 C.F.R. § 1.78(a)(1).

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

WARNING: *If an application claims the benefit of the filing date of an earlier filed application under 35 U.S.C. 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 U.S.C. 120, 121 or 365(c). (35 U.S.C. 154(a)(2) does not take into account, for the determination of the patent term, any application on which priority is claimed under 35 U.S.C. 119, 365(a) or 365(b).) For a c-i-p application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20,195, at 20,205.*

WARNING: *When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application must be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3).*

☐ The new application being transmitted claims the benefit of prior U.S. application(s). Enclosed are ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

3. Papers Enclosed

A. Required for filing date under 37 C.F.R. § 1.53(b) (Regular) or 37 C.F.R. § 1.153 (Design) Application

18 Pages of specification

3 Pages of claims

4 Sheets of drawing

WARNING: *DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. Only one copy is required or desired. For comments on proposed then-new 37 CFR 1.84, see Notice of March 9, 1988 (1990 O.G. 57-62).*

NOTE: "Identifying indicia, if provided, should include the application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8 inch) down from the top of the page . . ." 37 C.F.R. 1.84(c)).

(complete the following, if applicable)

☐ The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWING(S)." 37 C.F.R. 1.84(b).

☐ formal

☐ informal

B. Other Papers Enclosed

8 Pages of declaration and power of attorney

1 Pages of abstract

____ Other

4. Additional papers enclosed

☐ Amendment to claims

☐ Cancel in this applications claims _____ before calculating the filing fee. (At least one original independent claim must be retained for filing purposes.)

☐ Add the claims shown on the attached amendment. (Claims added have been numbered consecutively following the highest numbered original claims.)

☒ Preliminary Amendment

☒ Information Disclosure Statement (37 C.F.R. 1.98)

☒ Form PTO–1449 (PTO/SB/08A and 08B)

☒ Citations

☐ Declaration of Biological Deposit

☐ Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

☐ Authorization of Attorney(s) to Accept and Follow Instructions from Representative

☐ Special Comments

☐ Other

5. Declaration or oath (including power of attorney)

NOTE: A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. §§ 1.63(d)(1)–(3).

NOTE: A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)–(4).

☒ Enclosed

Executed by

(check **all** *applicable boxes)*

☒ inventor(s).

☐ legal representative of inventor(s). 37 CFR 1.42 or 1.43.

☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached.

☐ This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. See item 13 below for fee.

☐ Not Enclosed.

NOTE: Where the filing is a completion in the U.S. of an International Application or where the completion of the U.S. application contains subject matter in addition to the International Application, the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.

☐ Application is made by a person authorized under 37 C.F.R. 1.41(c) on benalf of *all* the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 CFR 1.16(e) can be filed subsequently).

☐ Showing that the filing is authorized. *(not required unless called into question. 37 CFR 1.41(d))*

6. Inventorship Statement

WARNING: *If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted.*

The inventorship for all the claims in this application are:

☐ The same.

or

☐ Not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted.

☐ will be submitted.

7. Language

NOTE: *An application including a signed oath or declaration may be filed in a language other than English. An English translation of the non-English language application and the processing fee of $130.00 required by 37 CFR 1.17(k) is required to be filed with the application, or within such time as may be set by the Office. 37 CFR 1.52(c).*

☒ English

☐ Non-English

☐ The attached translation includes a statement that the translation is accurate. 37 C.F.R. 1.52(d).

8. Assignment

☒ An assignment of the invention to Nokia Mobile Phones Ltd.

☒ is attached. A separate ☒ "COVER SHEET FOR ASSIGNMENT (DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or ☐ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: *"If an assignment is submitted with a new application, send two separate letters-one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).*

WARNING: *A newly executed "CERTIFICATE UNDER 37 CFR 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.*

9. Certified Copy

Certified copy(ies) of application(s)

Country	Appln. No.	Filed
Finland	980150	23 January 1998
Country	Appln. No.	Filed
Country	Appln. No.	Filed

from which priority is claimed

☒ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority must be referred to in the oath or declaration. 37 CFR 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. 120 is itself entitled to priority from a prior foreign application, then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 C.F.R. 1.16)

A. ☒ Regular application

CLAIMS AS FILED				
Number filed	Number Extra		Rate	Basic Fee 37 C.F.R. 1.16(a) $760.00
Total Claims (37 CFR 1.16(c)) 14 – 20 =	0	×	$ 18.00	
Independent Claims (37 CFR 1.16(b)) 3 – 3 =	0	×	$ 78.00	
Multiple dependent claim(s), if any (37 CFR 1.16(d))		+	$ 260.00	

☐ Amendment cancelling extra claims is enclosed.

☒ Amendment deleting multiple-dependencies is enclosed.

☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims cancelled by amendment, prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 CFR 1.16(d).

Filing Fee Calculation $ 760.00

B. ☐ Design application
($ 310.00—37 CFR 1.16(f))

Filing Fee Calculation $_____

C. ☐ Plant application
($ 480.00—37 CFR 1.16(g))

Filing fee calculation $_____

11. **Small Entity Statement(s)**

☐ Statement(s) that this is a filing by a small entity under 37 CFR 1.9 and 1.27 is (are) attached.

WARNING: *"Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d)), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) of a prior application, or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to the statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section." 37 C.F.R. § 1.28(a)(2).*

(complete the following, if applicable)

☐ Status as a small entity was claimed in prior application

______ / ______________, filed on ______________, from which benefit is being claimed for this application under:

35 U.S.C. ☐ 119(e),
☐ 120,
☐ 121,
☐ 365(c),

and which status as a small entity is still proper and desired.

☐ A copy of the statement in the prior application is included.

Filing Fee Calculation (50% of **A**, **B** or **C** above)

$______________

NOTE: Any excess of the full fee paid will be refunded if small entity status is established and a refund request are filed within 2 months of the date of timely payment of a full fee. The two-month period is not extendable under § 1.136. 37 CFR 1.28(a).

12. **Request for International-Type Search** (37 C.F.R. 1.104(d))

(complete, if applicable)

☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made at This Time

☐ Not Enclosed

☐ No filing fee is to be paid at this time.
(This and the surcharge required by 37 C.F.R. 1.16(e) can be paid subsequently.)

☒ Enclosed

☒ Filing fee	$ 760.00
☒ Recording assignment ($40.00; 37 C.F.R. 1.21(h)) (See attached "COVER SHEET FOR ASSIGNMENT ACCOMPANYING NEW APPLICATION".)	$ 40.00
☐ Petition fee for filing by other than all the inventors or person on behalf of the inventor where inventor refused to sign or cannot be reached ($130.00; 37 C.F.R. 1.47 and 1.17(i))	$
☐ For processing an application with a specification in a non-English language ($130.00; 37 C.F.R. 1.52(d) and 1.17(k))	$
☐ Processing and retention fee ($130.00; 37 C.F.R. 1.53(d) and 1.21(l))	$
☐ Fee for international-type search report ($40.00; 37 C.F.R. 1.21(e))	$

NOTE: 37 CFR 1.21(l) establishes a fee for processing and retaining any application that is abandoned for failing to complete the application pursuant to 37 CFR 1.53(f) and this, as well as the changes to 37 CFR 1.53 and 1.78(a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid, or the processing and retention fee of § 1.21(l) must be paid, within 1 year from notification under § 53(f).

Total fees enclosed $ 800.00

14. Method of Payment of Fees

☒ Check in the amount of $ 800.00

☐ Charge Account No. _____ in the amount of $_____

A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 CFR 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: *If no fees are to be paid on filing, the following items should not be completed.*

WARNING: *Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.*

[X] The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 16-1350:

- [X] 37 C.F.R. 1.16(a), (f) or (g) (filing fees)
- [X] 37 C.F.R. 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: *Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.*

- [X] 37 C.F.R. 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)
- [X] 37 C.F.R. §§ 1.17(a)(1)-(5) (extension fees pursuant to § 1.136(a)).
- [ ] 37 C.F.R. 1.17 (application processing fees)

NOTE: *". . . A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).*

- [ ] 37 C.F.R. 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 C.F.R. 1.311(b))

NOTE: *Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).*

NOTE: *37 CFR 1.28(b) requires "Notification of any change in status resulting in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying, . . . the issue fee. . . ." From the wording of 37 CFR 1.28(b), (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.*

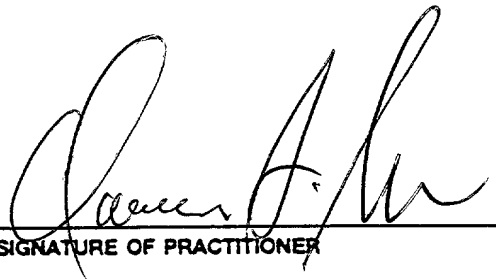
16. Instructions as to Overpayment

NOTE: ". . . Amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payer be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

☒ Credit Account No. 16-1350

☐ Refund

SEND ALL CORRESPONDENCE TO:



SIGNATURE OF PRACTITIONER

Clarence A. Green

(type or print name of attorney)

PERMAN & GREEN, LLP

P.O. Address
425 Post Road
Fairfield, CT 06430

Reg. No. 24,622

Tel. No. (203) 259-1800

Customer No.

☐ **Incorporation by reference of added pages**

(check the following item if the application in this transmittal claims the benefit of prior U.S. application(s) (including an international application entering the U.S. stage as a continuation, divisional or C-I-P application) and complete and attach the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED)

☐ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S. Application(s) Claimed

Number of pages added _____

☐ Plus Added Pages for Papers Referred to in Item 4 Above

Number of pages added _____

☐ Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application.

Number of pages added _____

☐ Plus "Assignment Cover Letter Accompanying New Application"

Number of pages added _____

☒ **Statement Where No Further Pages Added**

(if no further pages form a part of this Transmittal, then end this Transmittal with this page and check the following item)

☒ This transmittal ends with this page.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Express Mail No.: EL067101068US

In re Application of: KNUUTILA et al.

SERIAL NUMBER: EXAMINER:

FILING DATE: Herewith ART UNIT:

TITLE: METHOD FOR TRANSFERRING IMAGE INFORMATION

ATTORNEY DOCKET NO.: 460-008437-US(PAR)

The Commissioner of Patents and Trademarks

Washington, D.C. 20231

PRELIMINARY AMENDMENT

Dear Sir:

Please amend the above-identified, enclosed patent application as follows:

IN THE CLAIMS:

Please amend Claims 4, 6, 10 and 12 as shown below.

Claim 4, line 1, delete "or 3".

Claim 6, line 1, delete "or 5".

Claim 10, line 1, delete "or 9".

Claim 12, line 1, delete "any of the claims 8 to 11" and insert --claim 8--.

REMARKS

Prior to calculation of the fees, please enter this preliminary amendment.

Respectfully submitted,

19 Jan 99

Clarence A. Green, Reg. No. 24,622
PERMAN & GREEN, LLP
425 Post Road
Fairfield, CT 06430
(203) 259-1800

Date

Method for transferring image information

The present invention relates to a method for transferring image information according to the preamble of the appended claim 1, a camera module according to the preamble of the appended claim 7, and a mobile station according to the preamble of the appended claim 13.

In digital cameras and video cameras, an optical image is converted into electrical form by an image sensor, typically a charge coupled device (CCD). Such an image sensor consists of several photosensitive picture elements (pixels) which are arranged advantageously in a matrix form. The number of pixels in the image sensor affects the resolution of the image to be formed. Typically, the image sensor used in cameras and video cameras consists of hundreds of thousands of pixels, for example 640 x 480 = 307 200 pixels. In a CCD sensor, light induces a charge in the pixel, which is affected *e.g.* by the intensity of the light as well as the time of action of light in the pixel, *i.e.* exposure time. Cameras are equipped with optics whereby the image is focused at the pixels of the image sensor. When a CCD sensor is used, the pixels are uncharged before taking the picture, whereby after a predetermined exposure time, each pixel has a charge which is proportional to the quantity of light directed to it and which can be measured. After the exposure, the entry of light in the CCD sensor is prevented *e.g.* with a mechanical shutter. The shutter function can be implemented also electrically by sufficiently quick reading of the image sensor.

In the CCD sensor, the pixels are chained by coupling them in series, and the output of the CCD sensor is coupled with the first pixel in the connection in series, whereby the image signal from the CCD sensor can be read by transferring charges from one pixel to the next, timed by a charge transfer signal. The charges can be read from the output of the CCD element, whereby the charge of the pixel coupled to the output is read first. In the same connection, the charge transfer signal induces the transfer of charges in other pixels to the next pixel, *i.e.* the pixel coupled to the output will receive the charge of the second pixel coupled to the same, the second pixel will receive the charge of the pixel that is third in the connection in series, respectively, *etc.* Each line

of the image sensor can form a separate pixel chain. Each pixel chain is provided with a separate output from the first pixel in the chain, as presented above. From these outputs from the pixel chains, the charges can be transferred *e.g.* to a transfer register. Reading a CCD image sensor formed in this way requires transfers of charges in a way corresponding to the number of pixels in the pixel chain. Thus, measuring the charge of a single pixel is not possible except by carrying out the transfer of charges as presented above as long as the charge of the desired pixel is in the output of the image sensor. Using such an image sensor, undersampling of the image is difficult and slow because, in practice, the charges of all pixels in the pixel chain must be transferred to the output even though some of the pixels were not processed in undersampling.

The conversion of an analog signal generated by the image sensor to digital form can be conducted with an analog/digital converter. The conversion accuracy of the analog/digital conversion is typically 8 bits, whereby 256 luminous intensity levels are obtained from each pixel. Considering the capacity of human eye, this number is usually sufficient to provide the required image quality. From the analog/digital converter, this conversion result is transferred in parallel form for further processing steps, such as for storing in an image memory or on a video tape. In digital cameras and video cameras of prior art, the display device used is an analog display device, such as a LCD display device equipped with an analog connection, whereby the image is transferred as an analog signal to the display device.

In addition to the above-mentioned CCD sensors, recent development has involved so-called CMOS image sensors, whereby it is also possible to conduct the photoelectric conversion of the image. These CMOS image sensors are based on primarily two different operating principles: integrating and non-integrating image sensors.

In integrating image sensors, the current generated by the pixel is used to charge a capacitor arranged in connection with the pixel. The charge of the capacitor depends on the strength and charge time of the current induced by the pixel. Before image formation, each capacitor is uncharged, after which the current generated by the pixel starts to charge

the capacitor, whereby the charge accumulated in the capacitor after the exposure is proportional to the quantity of light to which the pixel was exposed. Setting the exposure time of integrating CMOS image sensors can be handled *e.g.* by a mechanical shutter, whereby the control electronics can be made simpler whereby the exposure time of each image element is substantially the same, or by timing the discharging of the capacitor and measuring of the accumulated charge substantially the same for different pixels. In an integrating image sensor, a charge is also accumulated in the capacitor when the pixel is in darkness. This may distort the image signal from the pixel. To correct this, a so-called correlated double sampling (CDS) method has been developed, whereby the charge of the capacitor of the pixel is measured after charge resetting preferably before exposure, and this value is stored for each pixel. The charge of the capacitor is measured again after the exposure time, and the stored value is subtracted from this measurement value. The difference corresponds better to the real image signal proportional to the quantity of light than an image signal obtained by one measurement. After the charge measurements presented above, the measurement value is subjected to analog/digital conversion, whereby the measurement result can be stored in digital form.

In non-integrating CMOS image sensors, the current generated by each pixel is measured, which is proportional to the intensity of light to which the pixel is exposed at the time. This kind of a sensor has the advantage that each pixel can be designated separately and the current can be measured irrespective of other pixels and exposure times. This random access is easier in integrating image sensors, if a mechanical shutter is used to set the same exposure time for different pixels.

CMOS image sensors can be also divided into passive and active image sensors. Their primary difference lies in the fact that in active image sensors, the pixel is also provided with an intensifier. This reduces the spreading of the charge of capacitors in the integrating image sensor to the next capacitors at the stage of measuring the charge, which may distort the measuring results in passive image sensors.

Irrespective of the type of the image sensor, the digitised values of the pixels are transferred for further processing typically in analog form, pixel by pixel. Thus, the image field is scanned for example line by line, starting from the first pixel on the first line. The analog image signal can be sent to be displayed *e.g.* by an analog display device. At the stage of further processing, the analog image signal can be converted to digital form *e.g.* for storage in an image memory, whereby the digital value formed from the analog signal of each pixel is stored in a memory location corresponding to the pixel in question. The image signal can be subjected to *e.g.* filtering and noise suppression, if necessary.

In currently known camera modules comprising an image sensor and control logic, the image information can be read either in analog form, whereby the signal must be subjected to analog/digital conversion for further processing steps, or readily converted in parallel digital form. Further, the synchronisation of image information is conducted by the control logic of the camera module in a predetermined image format, whereby typically a standard quantity of information must be transferred from each image. The quantity of information for one image depends on the number of pixels in the image sensor, *i.e.* the resolution, and the accuracy of the analog/digital conversion of each pixel. For example, in an image sensor consisting of 480 horizontal lines and 640 vertical lines, thereby comprising 307 200 pixels, each of which is subjected to analog/digital conversion of 8 bits, the total information of one image amounts to 2 457 600 bits.

When such a camera module of prior art is connected to a portable electronic device, such as a mobile station, one problem is the greater space needed by the parallel bus solution, compared with using a serial bus for the transfer of image information. In a typical application, information of 8 bits per pixel is used in a black-and-white image and information of 24 bits per pixel in a colour image, whereby at least 8 parallel transfer lines are needed. When a separate camera module is used, the coupling cable to be connected with the parallel bus should comprise conductors for each line of the parallel bus and also a ground conductor and possibly a power supply conductor for the camera module, whereby the coupling conductor becomes considerably more expensive and stiffer to use than a coupling cable of a serial bus con-

taining fewer conductors. Furthermore, possible capacitive coupling between signal transfer lines in the parallel bus may cause cross-talk between adjacent conductors. Cross-talk is easily increased when the length of the conductors is increased. Furthermore, parallel data transmission complicates the structure of the device to be connected to the camera module and increases the manufacturing costs.

The use of a serial bus in solutions of prior art would typically require increasing the data transfer rate at least 8 times compared with data transfer in parallel form, if the aim is to transfer the same quantity of information in the same time. This is not always possible, because fast digital signals have very sharp edges, *i.e.* the rise and fall times of the signal are very short, whereby they easily induce disturbances in the operation of the electronic device as well as other electronic devices. Also, signals containing rapid changes are susceptible to distortions which may affect the reliability of the data transfer.

One disadvantage with present camera modules is their inflexibility; they produce an image in a determined form at a rate determined by the camera module itself. Information produced by camera modules of prior art cannot be easily affected, whereby it may be necessary to conduct unnecessary functions in the device receiving the image signal particularly when the quantity of image information entering the receiving device exceeds the quantity that can be utilised in the receiving device, whereby transferring the unutilised image information consumes power to an unnecessary degree. Some camera modules of this kind provide the option of adjusting how often a new image is transferred from the camera module. However, the quantity of information in each image is not changed. If the receiving device cannot process all images at the set updating rate but controls the camera module to transfer images at a slower rate, the updating rate may sink to such a low level that it can be detected in the image *e.g.* as discontinuous movement.

In several digital cameras, an LCD display device is presently used for displaying image information. This display device is used both as a viewfinder for directing the camera to the desired photographic subject and for observing the picture taken, whereby the picture can be taken again, if necessary. Display devices of this kind are typically analog,

whereby the image signal is in analog form. When used as a viewfinder, the image displayed with a display device must be updated at a sufficient rate. The frequency of updating the image is limited by the large quantity of image information to be transferred and the limited transfer rate. This results in discontinuous movement of the image to be displayed on the display device, particularly during movement of the camera or the photographic subject. Also in several video cameras, an analog LCD display device is currently used as a viewfinder, whereby the problems are similar during video recording.

It is an aim of the present invention to provide an improved method for transferring image information *e.g.* to an electronic device, and a camera module from which image information can be transferred in serial form from an electronic device which may also control the transfer of the image. In addition, the image format can be modified according to the need. The method of the invention is characterised in what will be presented in the characterising part of the appended claim 1. The camera module of the invention is characterised in what will be presented in the characterising part of the appended claim 7. Furthermore, the mobile station of the invention is characterised in what will be presented in the characterising part of the appended claim 13. The invention is based on the idea that image information is transferred in serial form to an electronic device at a rate determined by the same. Furthermore, the quantity of image information to be transferred can be adjusted, whereby *e.g.* in viewfinder mode it is possible to display images with less image information at a sufficient rate so that disturbing jerky movement is not shown in the image to be displayed on a display device. When taking the final picture, the quantity of image information is raised to a desired level.

The present invention gives significant advantages compared with prior art. In a camera implemented by the method of the invention, the viewfinder mode and video recording can be implemented so that the image follows the movements of the camera or the imaging object. In simple photography, the final photograph can be, nevertheless, taken with a resolution which is as high as that possible in cameras of prior art. In video recording, a sufficient image quality is obtained in normal situations. Using the camera module of the present invention, the size

and power consumption of the electronic device can be made smaller than when using camera modules of prior art. Moreover, the solutions for transferring image information according to the invention do not require increasing the signal transfer rate, whereby the number of disturbances can be kept significantly smaller than is possible when using solutions of prior art, the image transfer rate being the same.

Furthermore, the present invention gives the advantage that the data transfer bus between the camera module and the electronic device can be made simpler and the connection means for connecting the camera module can be made simpler in the electronic device.

In the following, the invention will be described in more detail with reference to the appended drawings, in which

Fig. 1a shows functional blocks of a camera module according to a preferred embodiment of the invention,

Fig. 1b shows the camera module according to a preferred embodiment of the invention in a reduced block chart,

Fig. 2a shows the connection of the camera module according to a preferred embodiment of the invention as a separate device to a mobile station, and

Fig. 2b shows the integration of the camera module according to a preferred embodiment of the invention in a mobile station.

Figure 1a shows functional blocks of a camera module according to a preferred embodiment in a reduced manner. For the photoelectronic conversion of the image, the camera module 1 has an image sensor 2 which in this example is a non-integrating CMOS image sensor, but the invention can also be applied in other types of image sensor, such as integrating CMOS image sensors and CCD image sensors. The resolution of the image sensor 2 is for example 640 x 480, but the resolution as such has no significance in applying this invention. For clarity, not all pixels are shown in the drawings but as examples the first pixel P1,1, the second pixel P2,1 and last pixel Pm,1 of the first line, the

first pixel P1,2 of the second line, and the last pixel Pm,n of the last line are illustrated. A line selector 3 is used to select the pixel line to be examined at a time, and a column selector 4 is used to select the desired pixel P1,1—Pm,n of the line selected by the line selector 3, the current generated by the pixel being conducted to the output 5 of the column selector 4. Thus, the output 5 of the column selector contains the current generated by the selected pixel P1,1—Pm,n which is proportional to the intensity of light to which said pixel P1,1—Pm,n is exposed at the moment of reading. When using an integrating image sensor or a CCD image sensor, the charge is proportional to the intensity of the light to which the pixel P1,1—Pm,n is exposed and to the exposure time, whereby a means is also required to discharge each pixel P1,1—Pm,n. As mentioned earlier in this description, it is not easy to implement addressing of single pixels P1,1—Pm,n in CCD image sensors and integrating CMOS image sensors, but in other respects, the operation of the camera module 1 according to the invention is essentially similar to that when using a non-integrating image sensor 2.

The output 5 of the column selector is coupled to a sample and hold circuit 6. The output voltage of the sample and hold circuit 6 is set at the moment of sampling substantially the same as the input voltage of the sample and hold circuit 6. This output voltage is kept substantially constant until the next sampling instant or during the holding time of the sample and hold circuit 6. With this sample and hold circuit 6, it is possible to keep the measuring voltage supplied to the analog/digital converter 7 for the time required for analog/digital conversion, whereby the analog/digital conversion is as reliable as possible. If necessary, the digital conversion result of the analog/digital converter 7 is sent to a pre-processing block 8 where the image information can be subjected to some conversion and/or filtering operations, such as conversion of colour image format, conversion of image information for different display devices, and image undersampling.

If the image sensor 2 is intended for taking colour images, each pixel P1,1—Pm,n can consist of three partial elements for different colour components. Typically, a so-called RGB image format (red, green, blue) is used, whereby each colour component can be subjected to a separate photoelectric conversion. This can take place for example by

arranging a red filter in front of the pixel measuring the red colour component, preventing the pixel from being exposed to light at substantially other than red wavelengths; in a corresponding manner, a green filter is arranged in front of the pixel measuring the green colour component, and a blue filter is arranged in front of the pixel measuring the blue colour component. In the final image, one dot consists of these three pixels. These pixels corresponding to different colour components can be placed side by side for example on the same line or in the form of an isosceles triangle. Thus, for determining one dot, it is necessary to examine the signal formed by three pixels. This can be done *e.g.* so that the analog/digital conversion is conducted in the camera module 1 for each colour component one after the other using the same sample and hold circuit 6 and analog/digital converter 7. In another alternative, separate sample and hold circuits and analog/digital converters are arranged for each colour component. Thus, each colour component is further provided with a selector, preferably a column selector 4.

Furthermore, colour image sensors have been developed in which the number of pixels is the same as in a monochrome image sensor. This is achieved *e.g.* in a way that every other pixel is a pixel measuring green light, every fourth one is a pixel measuring red light and every fourth one a pixel measuring blue light. This is based on the capacity of the human eye; the sensitivity to different colours is different. Information given by the green pixel can be used as luminance information almost directly. In the final image signal, for example a group of four pixels is used to form the image signal of one dot. These methods are disclosed in more detail *e.g.* in patents US-4,642,678 and US-4,630,307.

The conversion of colour format *e.g.* from the RGB colour format to a so-called YCbCr format can be conducted by calculation as follows:

(1a) $Y = 0.299\ R + 0.587\ G + 0.114\ B$

(1b) $Cb = -0.168\ R - 0.331\ G + 0.5\ B$

(1c) $Cr = 0.5\ R - 0.4187\ G - 0.0813\ B$

The luminance component Y indicates the grey tones of the image, and this can be used *e.g.* in displaying a black-and-white image and in displaying a colour image as a black-and-white image. There are two

chrominance components, Cb and Cr, which contain the colour information of the image.

From the pre-processing block 8, the image information is transferred to the memory 18 of the camera module. From the memory 18, the image information can be transferred to a parallel/series converter 9 where the digitised image information of each pixel P1,1—Pm,n is converted to serial form. The image information can thus be read in serial form from a serial connection bus 10. As the data transfer format in this serial bus, it is possible to use serial data transfer formats known as such, for example in a way that the image information of 8 bits is framed with initial and terminal bits. The transfer of the image information is advantageously controlled by the electronic device, as will be disclosed below in this description.

For controlling the above-mentioned functional blocks, the camera module 1 is further provided with a control block 11, which in this preferred embodiment includes four control registers 12 to 15 and a timing block 33. A sample register 12 determines at which moment the sample and hold circuit 6 takes a sample from the output 5 of the column selector. A quality register 13 determines the accuracy of the conversion to be conducted by the analog/digital conversion. A pre-processing register 14 determines whether an image format conversion is to be conducted in the pre-processing block 8 and also whether image information in digital form is to be undersampled. The parallel/serial converter 9 is further provided with a parallel/serial conversion register 15 which controls data transfer on the serial bus 10. The control block also takes care of the operations needed for taking a picture, such as resetting the charges of the pixels P1,1—Pm,n and timing the measurement of the charges of the pixels P1,1—Pm,n.

A control serial bus 16 is connected to the control block 11 of the camera module 1 *e.g.* for transferring control commands and parameters to the control block 11. The control block 11 comprises further means (not shown) for controlling the line selector 3 and the column selector 4.

Figure 1b shows a camera module 1 according to an advantageous embodiment of the invention in a reduced block chart. In the camera

module 1 of Fig. 1b, *e.g.* the pre-processing block 8, the parallel/serial converter 9 and the control block 11 of Fig. 1a are implemented in the digital signal processing unit 17 (DSP). In Fig. 1b, the image sensor 2 and the line selector 3 and column selector 4 are shown in one block 2'. In a corresponding manner, the sample and hold circuit 6 and the analog/digital converter 7 are shown in one block 7'. The signal processing unit 17 is provided with a memory 18, preferably at least a random access memory RAM, *e.g.* for temporary data storage. Furthermore, the memory 18 contains the control commands or the like required for controlling the operation of the digital signal processing unit 17. The memory 18 is coupled via a memory connection block 19 to the system bus 20 of the digital signal processing unit. The system bus 20 includes a data bus, an address bus and a control bus, but these are not shown separately, and the practical implementation of these buses is prior art to someone skilled in the art.

The digital signal processing unit 17 further comprises a serial connection circuit 21. It includes a parallel/serial conversion block for the information to be transmitted to the serial bus 10, as well as for converting serial form control information from the control serial bus 16 into parallel form for transmission to the system bus 20.

The signal processing and control block 22 of the digital signal processing unit 17 controls the image sensor 2' for reading the image information of the pixels P1,1—Pm,n. This is conducted advantageously so that in the selection lines of the line selector, which are shown as one line and indicated by the reference RSEL in Fig. 1a, the binary value is set to correspond to the desired line of the image; to select the first line, the value 0; to select the second line, the value 1, *etc.* Furthermore, an output enabling line OE1 is conducted to the line selector, to change the state of the line selection line corresponding to the binary value set in the selection lines to another logical state, *e.g.* logical 0 state. Thus, the logical 1 state corresponds to a situation where the line is not selected. In the logical 0 state, the first connection interface (conductor) of the pixels coupled to said line is set close to 0 V. In a corresponding manner, in the selection lines SSEL of the column selector, the binary value is set to correspond to the column to be examined. As a result, the input line of the column selector, connected to the corresponding

column lines of the image sensor, is coupled to the output line 5 of the column selector, whereby the signal of this line 5 corresponds to the signal of the selected pixel, which can be converted into digital form.

Figure 2a shows the connection of a camera module 1 according to a preferred embodiment of the invention as a separate module to an electronic device, preferably a mobile station 23, by means of an external connection bus 24. The external connection bus 24 comprises a serial bus 10 and a control serial bus 16, whereby control information can be transferred from the mobile station 23 to the camera module 1 and image information can be transmitted from the camera module 1 to the mobile station 23, respectively. The mobile station 23 is provided *e.g.* with a control unit 25 comprising advantageously a microprocessor CPU or a corresponding processor, a memory 26 and a serial connection block 31 (serial input/output) for coupling the external connection bus 24 to the mobile station 23. For example the serial/parallel conversions between the external serial bus 24 and the system bus 24 of the mobile station take place in the serial connection block 31. The memory 26 can be used *e.g.* for storing image information read from the camera module 1, whereby the image can be displayed for example with a display device 27. One advantage of this separate camera module 1 is that the same camera module 1 can be used in connection with different electronic devices equipped with the required connection means for connecting the external connection bus 24 with the electronic device. The external connection bus 24 can consist of conductors, or it can be implemented *e.g.* with infrared data transmission means.

Figure 2b shows a solution in which the camera module 1 according to the invention is integrated in the mobile station 23. Thus, an internal serial connection bus 28 is arranged between the camera module 1 and the control block 25 of the mobile station, to transfer control and image information between the camera module 1 and the control block 25 of the mobile station. The internal serial bus 28 is coupled to the serial connection block 31 of the mobile station which performs *e.g.* the serial/parallel conversions between the serial bus 28 and the system bus 32 of the mobile station. Using this integrated solution, it is possible to achieve a relatively compact mobile station 23 also equipped with the camera function. This has the advantage that no separate external

connection bus is needed between the camera module 1 and the control block 25 of the mobile station, and that the use of such an integrated device is in many situations easier than the use of two separate devices.

In the following, the operation of the method according to the invention will be described. It is assumed that the camera module 1 is intended for taking single photographs, corresponding to a normal digital photographic camera, and that the image sensor 2 is a non-integrating CMOS image sensor. When preparing for taking a picture, the camera module 1 is set to viewfinder mode, whereby image information of the camera module 1 is displayed on the display device 27, so that the user can direct the camera module 1 to the desired photographic subject and perform cut-out operations, if necessary. The optics of the camera module 1 can, in a manner known as such, comprise various objectives, exchangeable objectives and zoom objectives, but these will not be discussed in more detail in this context. The user sets the camera module 1 to viewfinder mode preferably by using the keypad 29 of the mobile station 23. The control block 25 of the mobile station interprets the button pressing and starts to set the function mode of the camera module 1. To set the function mode, the control block 25 of the mobile station sends the required control commands and parameters to the control block 11 of the camera module 1. These control commands contain the setting of registers according to predetermined parameters. For example, a command for taking a picture is set in the sampling register 12. In the quality register 13, the conversion accuracy is set for the analog/digital conversion of each sample, which may vary preferably from 1 to 8 bits in practical applications. In some cases, it may also be necessary to use a greater conversion accuracy. In viewfinder mode, the conversion accuracy is set smaller than in the actual photography mode, for example 4 bits instead of 8 bits. As a result, the analog/digital conversion converts the sample at an accuracy of four most significant bits (MSB), whereby the conversion is also faster than when using a greater conversion accuracy. In a converter based on sequential approximation, reduction of the conversion accuracy to a half means doubling of the conversion rate. With four bits, it is possible to present 16 different values, but this is a sufficient accuracy in viewfinder mode. Furthermore, an increase in the conversion rate

means that in the same time it is possible to transfer the image information of several pixels P1,1—Pm,n, whereby, as a result, the image can be updated more often on the display device 27.

Moreover, if desired, it is possible in the pre-processing register 14 to set information on whether the image information is to be subjected to a conversion, *e.g.* conversion of colour format. Furthermore, it is possible in the pre-processing register 14 to set information on undersampling, which means, for instance, that not all results of analog/digital conversion are transferred further but for example every second one, or only the value of every other pixel is converted, which will also increase the updating rate of image information. Undersampling reduces the resolution of the image, but, it is possible, if necessary, in the receiving device to form an image corresponding to the original resolution from the undersampled image, *e.g.* by interpolation on the basis of the received image information.

Furthermore, information is transferred from the control block 25 of the mobile station to the control block 11 of the camera module about the moment for taking the picture. This command can be transmitted by the mobile station 23 for example after the previous image has been processed. This applies particularly to non-integrating image sensors. The command for taking the picture can also be transmitted in advance, if taking the picture requires a longer exposure time, *e.g.* when an integrating sensor is used. Thus, after the transmission of the command for taking the picture, the mobile station 23 has sufficient time for processing the image under processing, before the camera module 1 takes a new picture, and unnecessary waiting for processing of the image can be avoided.

After the camera module has received the command for taking a picture, the control block 11 interprets the command and starts taking the picture. The control block 11 generates control signals for the line selector 3 and the column selector 4 to select the pixels P1,1—Pm,n preferably in a way that one image is read as quickly as possible to eliminate *e.g.* movement distortions in the image. The pixels are read for example in the following way. After receiving the necessary control commands and parameters, the control block 11 of the camera module

sets preferably the first pixel line of the image sensor 2 for reading, with the line selector 3. Next, with the column selector 4, the control block 11 selects the first column, whereby the current of this pixel is present at the output 5 of the column selector and is transferred to the sample and hold circuit 6. It may take a certain setting time to make the current value constant in the output 5 of the column selector before the control block 11 commands the sample and hold circuit 6 to sample this current. The setting time is advantageously some tens of nanoseconds. After the sample and hold circuit 6 has taken the sample, the control block 11 commands the analog/digital converter to start an analog/digital conversion at a precision determined in the quality register 13. The analog/digital converter 7 typically comprises a status line or the like, by means of which the control block 11 can monitor the completion of the analog/digital conversion. After completion of the analog/digital conversion, the control block 11 transfers the conversion result to the pre-processing block 8 and performs pre-processing, if necessary. After this, the image information of the pixel is stored in the memory 18 of the camera module 1, in a memory space allotted to the selected pixel. Next, the control block 11 sets in the column selector 4 information whereby the column selector 4 selects the current of the next pixel into the output 5. This current value is subjected to the same operations as presented above. After conversion of the pixels in the whole line, the control block 11 selects the next line to be converted, with the line selector 3. After the whole image field has been scanned, the image information is stored in the memory 18 and ready to be transferred. This transfer can be implemented *e.g.* in a way that the camera module 1 transmits information about the completion of the conversion result of the image to the serial bus 10, whereby the control block 25 of the mobile station transmits a command to start image transfer to the control serial bus 16, if the mobile station 23 is ready to receive the image information. After this, the control block 11 transfers the conversion result of the first pixel from the memory 18 to the parallel/serial converter 9, where the conversion result is converted into serial form and transferred to the serial bus 10. If necessary, it is also possible at this stage to reduce the quantity of information to be transmitted by leaving some of the less significant bits untransferred. The control block 25 of the mobile station receives this information and conducts serial/parallel conversion on the same, and transfers the

information to the memory 26 of the mobile station, to a memory location reserved for the selected pixel. Next, the information on the second pixel is transferred, and so forth, until the whole image has been transferred.

Next, the control block 25 of the mobile station for example displays the image on a display device 27 by transferring the image information from the memory 26 to the display device 27, where the image information is displayed at a location reserved for it. If the display device 27 is an analog display device, the image information is further subjected to digital/analog conversion before transferring to the display device 27.

When necessary, it is possible to crop a smaller area (window) from the image to be transferred to the mobile station 23. This is conducted preferably by sending the co-ordinates of two opposite edge points (line and column identifications) of the area to be transferred, together with information on the desired conversion accuracy and resolution of the image. Also in this situation, the camera module takes preferably a full picture and stores it in the memory, but only the image information on the desired area is transmitted to the serial bus 10.

Furthermore, the invention can be applied in a way that the camera module 1 always takes a picture with the maximum resolution and conversion accuracy and stores the image in the memory 18. Thus, the resolution and/or conversion accuracy is reduced at the stage of transferring information to the serial bus 10.

In viewfinder mode, the quantity of image information per image to be transferred is smaller than in normal photographic mode; consequently, images can be updated at a faster rate than when using solutions of prior art. Thus, the image is updated faster, and jerky movement cannot be noticed to a significant degree. Nevertheless, the final photograph can be taken with a higher resolution, whereby the control block of the mobile station transmits the required control commands and parameters to the control block 11 of the camera module 1. Taking a picture in this way can be implemented for example so that the user presses a predetermined button in the keypad 29 of the mobile station. Thus, the camera module 1 conducts conversion of the image at a

higher resolution, and after completion of the conversion, the camera module 1 transmits the serial bus 10 information about the completion of the image, whereby the control block 25 of the mobile station can start the transfer of the image information. In this case, the transfer of the image information takes a longer time than in the viewfinder mode, but, on the other hand, it is not significant.

The camera module 1 of the invention has the further advantage that image information can be transferred asynchronously in relation to the functions of the camera. Thus, the camera module 1 of the invention can be controlled in a way that it generates an image of the desired type, whereby it is possible, if necessary, to reduce the quantity of image information to be transferred. In camera modules of prior art, the image format and resolution can be changed, but the transfer of image information takes place at a constant rate determined by the camera module, whereby typically either a parallel bus or a fast serial bus is needed for transferring the information at a sufficient rate from the camera module to further processing stages.

Moreover, the camera module 1 of the invention can also be utilised in video recording, whereby each single image consists of a smaller quantity of image information than in camera modules of prior art, but the updating rate of the images can be raised, whereby a more realistic moving image is obtained. Also, pictures taken with the camera module 1 of the invention can be transmitted via a mobile communication network, if necessary. Thus, with reference to the block diagram of Fig. 2a/2b, the control block 25 of the mobile station reads the images in ways presented above and transfers the image information further to a radio element 30, from which the image information can be transmitted via a mobile communication network (not shown) to another mobile station or telecommunication terminal. Thus, the image information can be presented in the receiving telecommunication terminal. If necessary, the control block 25 of the mobile station compresses the image to be transferred to the radio element, whereby the data transmission can be enhanced in the mobile communication network. Because the processing of the image takes place primarily already in the camera module 1, the control block 25 of

the mobile station does not need to have such a large processing capacity as when camera modules of prior art are used.

The present invention is not limited solely to the embodiments presented above, but it can be modified within the scope of the appended claims.

Claims:

1. A method for transferring image information from a camera module (1) to an electronic device, such as a mobile station (23), in which camera module (1) an image is formed by an image sensor (2) comprising pixels where the light to which the pixels (P1,1—Pm,n) are exposed is converted into an analog signal which is converted into digital image information, **characterised** in that the image information is transferred in serial form and that the transfer of the image information is controlled from the electronic device (23).

2. The method according to claim 1, **characterised** in that the quantity of the image information to be transferred from the camera module (1) can be adjusted.

3. The method according to claim 2, **characterised** in that the adjustment of the quantity of image information to be transferred from the camera module (1) is conducted by adjusting the conversion accuracy of the analog/digital conversion.

4. The method according to claim 2 or 3, **characterised** in that the adjustment of the quantity of image information to be transferred from the camera module (1) is conducted by adjusting the resolution of the image.

5. The method according to claim 4, **characterised** in that the adjustment of the resolution of the image is conducted by undersampling of the image information.

6. The method according to claim 4 or 5, **characterised** in that in the electronic device (23), the resolution is restored by interpolation from the received image information.

7. A camera module (1) comprising an image sensor (2) with pixels (P1,1—Pm,n) for conducting photoelectric conversion, and means (6, 7) for conversion of the analog signal generated by said pixels into digital form, **characterised** in that the camera module (1) further comprises means (10) for transferring digital image information to an

electronic device, such as a mobile station (23), in serial form, and means (11, 16) for conducting the transfer of the image information under control by the electronic device (23).

8. The camera module (1) according to claim 7, **characterised** in that it further comprises means (11) for adjusting the quantity of image information to be transferred from the camera module (1).

9. The camera module (1) according to claim 8, **characterised** in that said means (11) for adjusting the quantity of image information to be transferred from the camera module (1) comprise means (13) for adjusting the conversion accuracy of the analog/digital conversion.

10. The camera module (1) according to claim 8 or 9, **characterised** in that said means (11) for adjusting the quantity of image information to be transferred from the camera module (1) comprise means (15, 33) for adjusting the resolution of the image.

11. The camera module (1) according to claim 10, **characterised** in that said means (33) for adjusting the resolution of the image comprise means (12, 13) for undersampling of the image information.

12. The camera module (1) according to any of the claims 8 to 11, **characterised** in that said means (11) for adjusting the quantity of image information to be transferred from the camera module (1) comprise means (15) for undersampling of the image information formed in the camera module (1).

13. A mobile station (23), **characterised** in that it comprises:

- means (10) for connecting a camera module (1), the camera module (1) comprising an image sensor (2) with pixels (P1,1—Pm,n) for conducting a photoelectric conversion, and means (6, 7) for converting the analog signal generated by the photoelectric conversion means to digital form, and
- means (24, 25) for controlling the transfer of image information formed by the camera module (1), and
- means (24) for transferring the image information formed by the camera module (1) to the mobile station (23) in serial form.

14. The mobile station (23) according to claim 13, **characterised** in that it further comprises means (11) for adjusting the quantity of image information to be transferred from the camera module (1).

Abstract

The invention relates to a method for transferring image information from a camera module (1) to an electronic device, such as a mobile station (23). In the camera module (1), an image is formed by an image sensor (2) comprising pixels, where the light to which the pixel (P1,1—Pm,n) is exposed is converted into an analog signal which is converted into digital image information. The image information is transferred in serial form, and the transfer of the image information is controlled by the electronic device (23).

Fig. 1a

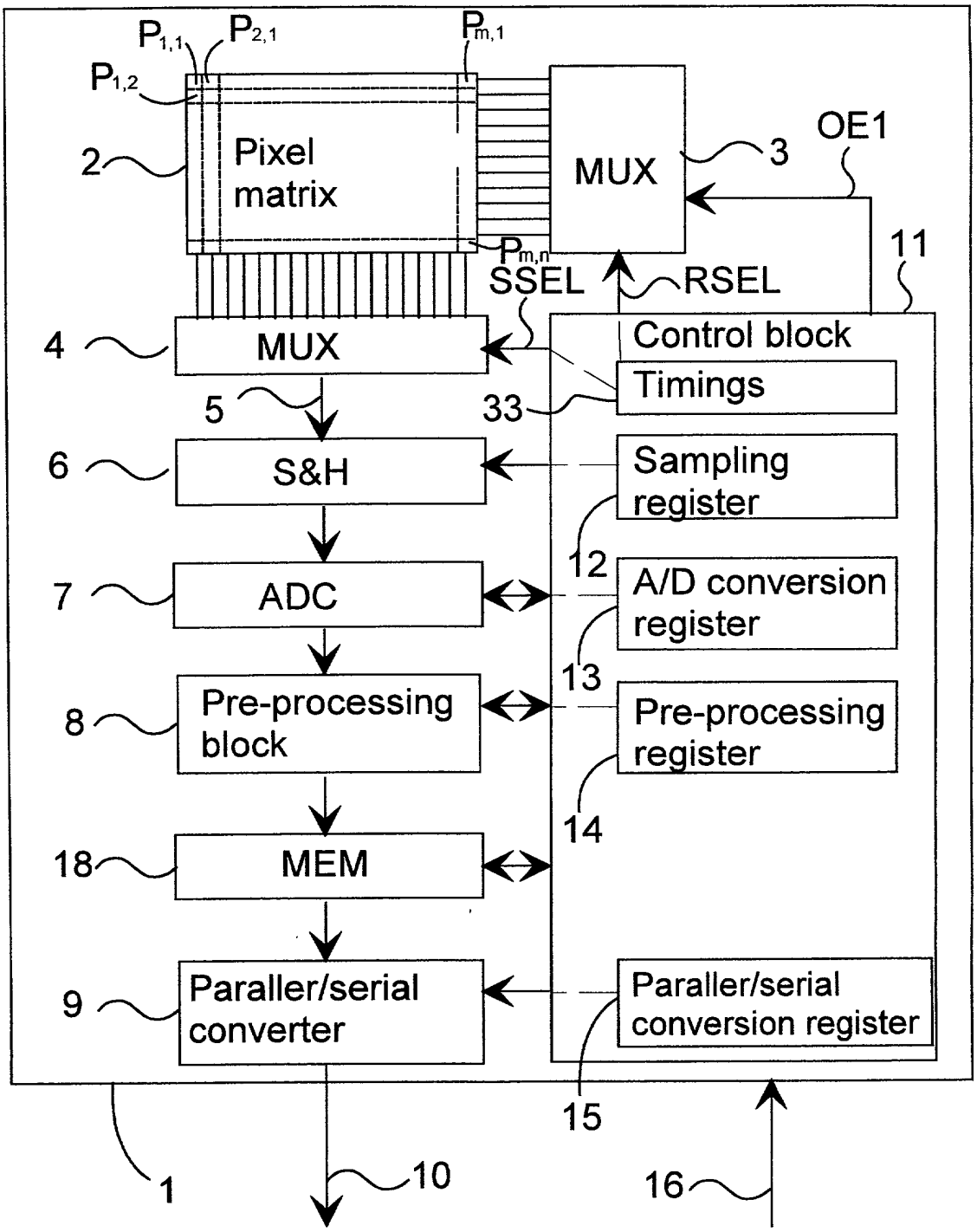

$P_{1,1}$
$P_{2,1}$
$P_{m,1}$
$P_{1,2}$
2
Pixel matrix
MUX
3
OE1
$P_{m,n}$
SSEL
RSEL
11
4
MUX
Control block
Timings
33
5
6
S&H
Sampling register
12
7
ADC
A/D conversion register
13
8
Pre-processing block
Pre-processing register
14
18
MEM
9
Paraller/serial converter
Paraller/serial conversion register
15
1
10
16

Fig. 1a

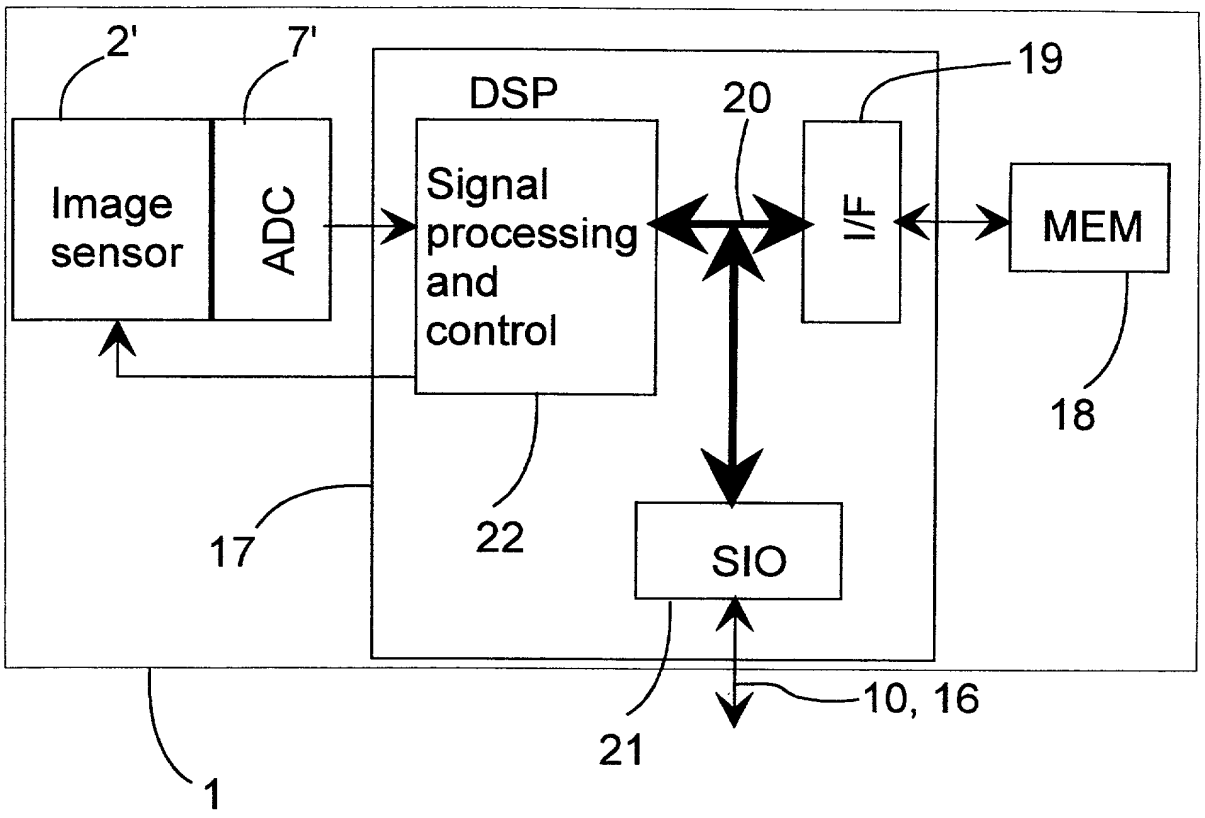

2'
7'
DSP
19
20
Image sensor
ADC
Signal processing and control
I/F
MEM
18
17
22
SIO
10, 16
21
1

Fig. 1b

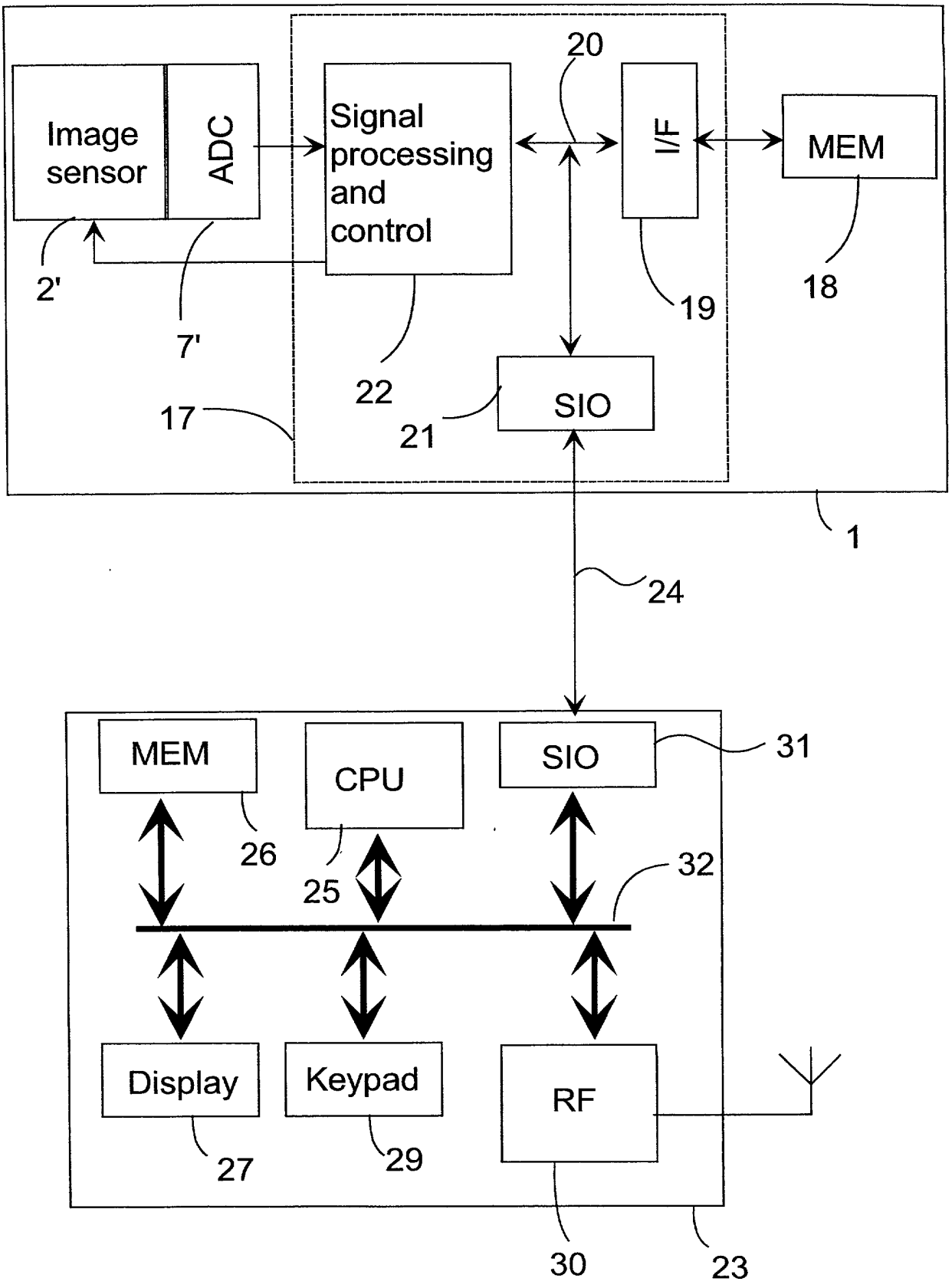


Image sensor
ADC
Signal processing and control
I/F
MEM
20
2'
7'
22
19
18
17
21
SIO
1
24
MEM
CPU
SIO
31
26
25
32
Display
Keypad
RF
27
29
30
23

Fig. 2a

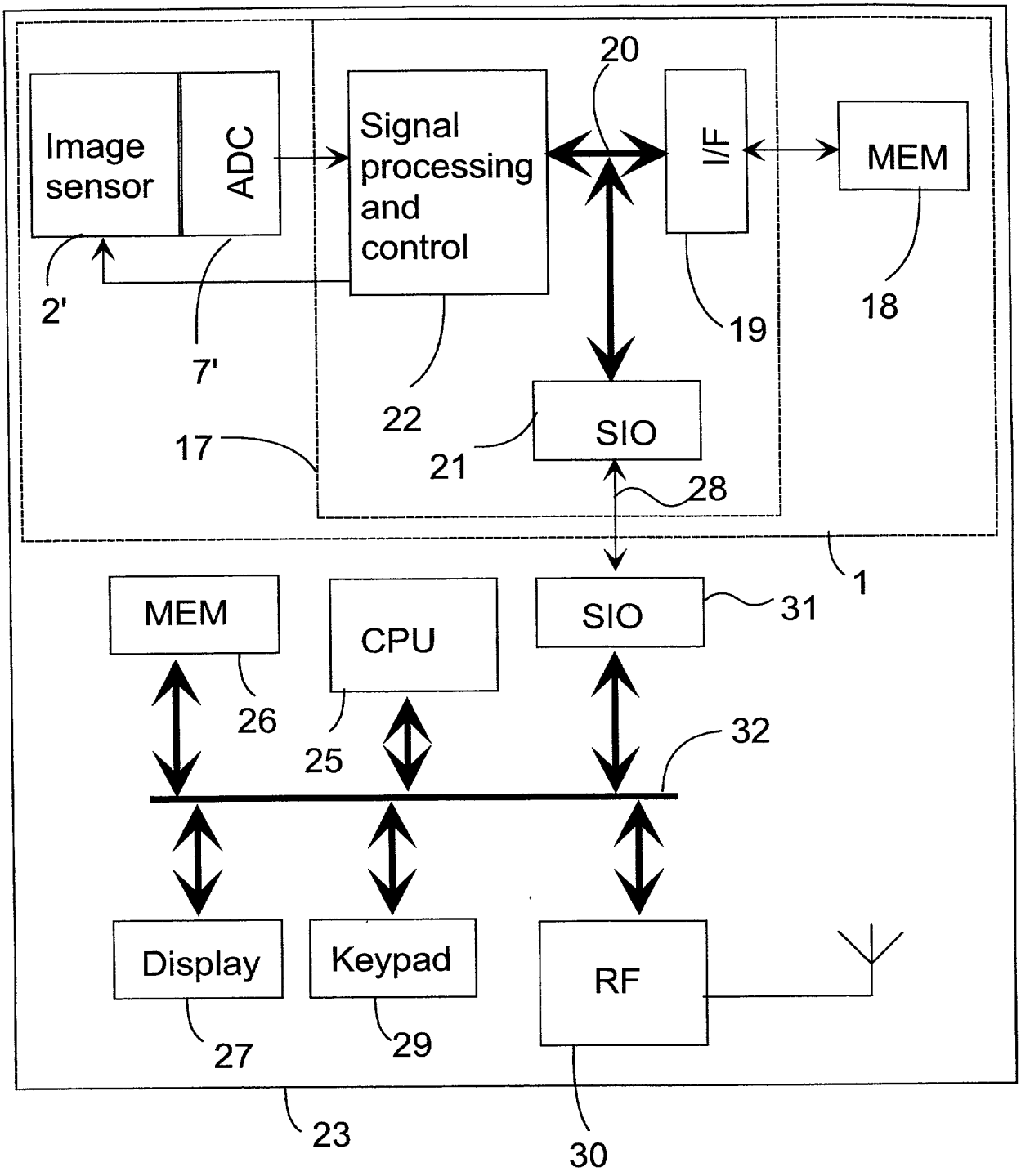


Image sensor
ADC
Signal processing and control
20
I/F
MEM
2'
7'
22
19
18
17
21
SIO
28
1
MEM
CPU
SIO
31
26
25
32
Display
Keypad
RF
27
29
23
30

Fig. 2b

Attorney's Docket No. _____ ***PATENT***

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

(check one applicable item below)

- ☒ original.
- ☐ design.
- ☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

- ☐ national stage of PCT.

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

- ☐ divisional.
- ☐ continuation.
- ☐ continuation-in-part (C-I-P).

INVENTORSHIP IDENTIFICATION

WARNING: *If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.*

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor *(if only one name is listed below)* or an original, first and joint inventor *(if plural names are listed below)* of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

Method for transferring image information

SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b) or (c))

(a) ☒ is attached hereto.

(b) ☐ was filed on _____, as ☐ Serial No. 0 /_____ or ☐ Express Mail No., as Serial No. not yet known _____ and was amended on _____ *(if applicable).*

NOTE: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 CFR 1.67.

(c) ☐ was described and claimed in PCT International Application No. _____, filed on _____ and as amended under PCT Article 19 on _____ *(if any).*

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and

☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119(a)–(d))

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)–(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) ☐ no such applications have been filed.

(e) ☒ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
Finland	980150	23 January 1998	☒ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐
			☐ YES NO ☐

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER	FILING DATE
_____ /_____	_____
_____ /_____	_____
_____ /_____	_____

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S) UNDER 35 U.S.C. 120

☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN PART (C-I-P) APPLICATION.

ALL FOREIGN APPLICATION(S), *IF ANY*, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

NOTE: *If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.*

POWER OF ATTORNEY

I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Clarence A. Green (24,622)
Harry F. Smith /32,493)
Mark F. Harrington (31,686)

(check the following item, if applicable)

☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named attorney(s) to accept and follow instructions from my representative(s).

SEND CORRESPONDENCE TO

Clarence A. Green
Perman & Green, LLP
425 Post Road
Fairfield, CT 06430

DIRECT TELEPHONE CALLS TO:
(Name and telephone number)

Clarence A. Green
(203) 250-1800

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of sole or first inventor

Jarno (GIVEN NAME) _____ (MIDDLE INITIAL OR NAME) Knuutila (FAMILY (OR LAST NAME))

Inventor's signature _____

Date 28th December 1998 **Country of Citizenship** Finland

Residence Matti Tapion katu 1 F 17, FIN-33720 Tampere, Finland

Post Office Address Matti Tapion katu 1 F 17, FIN-33720 Tampere, Finland

---

Full name of second joint inventor, if any

Jari (GIVEN NAME) _____ (MIDDLE INITIAL OR NAME) Toivanen (FAMILY (OR LAST NAME))

Inventor's signature _____

Date 28th December 1998 **Country of Citizenship** Finland

Residence Mekaniikanpolku 18 C 42, FIN-33720 Tampere, Finland

Post Office Address Mekaniikanpolku 18 C 42, FIN-33720 Tampere, Finland

---

Full name of third joint inventor, if any

Janne (GIVEN NAME) Mikael (MIDDLE INITIAL OR NAME) Juhola (FAMILY (OR LAST NAME))

Inventor's signature _____

Date 16.12.1998 **Country of Citizenship** Finland

Residence Arkkitehdinkatu 15 D 13, FIN-33720 Tampere, Finland

Post Office Address Arkkitehdinkatu 15 D 13, FIN-33720 Tampere, Finland

(check proper box(es) for any of the following added page(s) that form a part of this declaration)

☒ **Signature** for fourth and subsequent joint inventors. *Number of pages added* 2.

* * *

☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. *Number of pages added* ______.

* * *

☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. *Number of pages added* ______

* * *

☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

* * *

☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added ______

* * *

☐ Authorization of attorney(s) to accept and follow instructions from representative.

* * *

(if no further pages form a part of this Declaration, then end this Declaration with this page and check the following item)

☐ This declaration ends with this page.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

Full name of fourth joint inventor, if any

Markku		Lipponen
(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature

Date 28th December 1998 Country of Citizenship Finland

Residence Simo Kaarion katu 1 A 2, FIN-33720 Tampere, Finland

Post Office Address Simo Kaarion katu 1 A 2, FIN-33720 Tampere, Finland

Full name of fifth joint inventor, if any

Ari		Aho
(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature

Date 28th December 1998 Country of Citizenship Finland

Residence Elementinpolku 13 A 6, FIN-33720 Tampere, Finland

Post Office Address Elementinpolku 13 A 6, FIN-33720 Tampere, Finland

Full name of sixth joint inventor, if any

Janne		Haavisto
(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature

Date 28th December 1998 Country of Citizenship Finland

Residence Havumetsänkatu 27 A 12, FIN-33720 Tampere, Finland

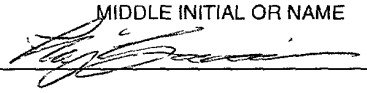
Post Office Address Havumetsänkatu 27 A 12, FIN-33720 Tampere, Finland

SIGNATURE(S)

NOTE: *Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.*

Full name of seventh joint inventor, if any

Kaj		Saarinen
(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature 

Date 28th December 1998 Country of Citizenship Finland

Residence Opiskelijankatu 30 A 14, FIN-33720 Tampere, Finland

Post Office Address Opiskelijankatu 30 A 14, FIN-33720 Tampere, Finland

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Full name of joint inventor, if any

(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address

Full name of joint inventor, if any

(GIVEN NAME)	MIDDLE INITIAL OR NAME	FAMILY (OR LAST NAME)

Inventor's signature

Date Country of Citizenship

Residence

Post Office Address